I13-2 – Diamond Manchester Imaging Branchline

I13 is dedicated to imaging and coherence related experiments and has been designed to support a broad range of scientific users from biomedicine, materials science, geophysics, astrophysics, archaeology and engineering applications. It is housed in a building 250 metres away from the main ring building, and similar to other beamlines at Diamond, it exploits Diamond’s brilliant X-rays and utilises them in two ways via X-ray Imaging (I13-2) and Coherence (I13-1) branch lines. These branch lines provide different tools, which can which can run simultaneously and independently from each other, for non-destructive examination of internal features ranging from the micrometre to the nanometre length scale.

The Imaging branch performs in-line phase contrast imaging and tomography over a large field of view in the 6-30 keV energy range. The spatial resolution for this technique is in the micron range. In addition it will be possible to switch the instrument to full-field microscopy with 50 nm spatial resolution.

Bio-Medical Research
- Characterise the performance of injectable bone substitutes in promoting bone growth;
- Investigate cochlea structure to understanding hearing;
- Imaging of soft tissues including muscles.

Energy
- Probe of lithium ion batteries;
- Image structures in nuclear storage materials.

Novel Imaging Techniques
- Imaging of biological cell structure;
- Probe the structure and organisation of photonic crystals;
- Reconstruct internal stress fields using coherent diffraction.

Materials
- Study the size distribution of aluminium grains in polycrystalline materials;
- Follow crack propagation in engineering materials;
- Dendritic growth of aluminium-tin alloys.

For further information please contact the Diamond Industrial Liaison Office on

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The imaging branch operates in two imaging modes:

**Micro-imaging**

Images are recorded with resolutions up to circa 1µm and a choice of magnifications.

<table>
<thead>
<tr>
<th>Detector</th>
<th>Objective lens</th>
<th>Total magnification*</th>
<th>Effective pixel size / µm</th>
<th>Field of view / mm</th>
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<td>0.55</td>
<td>1.1 x 1.1</td>
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</tbody>
</table>

**Nano-imaging**

An X-ray microscope is used to provide a resolution of approximately 50nm and a field of view of roughly 50µm and is currently undergoing optimisation to improve resolution and exposure times.

**pco.4000 (High image quality)**

- Scintillator-coupled detector
- 4008 x 2672 pixels
- Pixel size: 9 µm x 9 µm
- Dynamic range: 5,455:1
- Maximum frame rate at full resolution: 5 Hz
- Exposure time: 5 µs – 49 days
- Low noise

**pco.edge 5.5 (High image quality)**

- Scintillator-coupled detector
- 2560 x 2160 pixels
- Pixel size: 6.5 µm x 6.5 µm
- Dynamic range: 27,000:1
- Maximum frame rate at full resolution: 100 Hz
- Exposure time: 500 µs – 2s
- Very low noise

**pco.dimax S (High speed)**

- Scintillator-coupled detector
- 2160 x 2160 pixels
- Pixel size: 11 µm x 11 µm
- Dynamic range: 1,600:1
- Maximum frame rate at full resolution: 1,279 Hz
- Exposure time: 1.5 µs – 40 ms

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